MA 32C (88)-1

CURRENT INDUSTRIAL REPORTS

Refractories

1988

U.S. Department of Commerce
BUREAU OF THE CENSUS

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SUMMARY OF FINDINGS

In 1988, total manufacturers' shipments of refractories amounted to $1,965 million, an increase of 17 percent from 1987 shipments of $1,682 million.

Shiments of clay refractories increased 11 percent to $824 million in 1988 from $740 million in 1987. Castable refractories including gunning mixes accounted for 22 percent of clay shipments with a value of $180 million.

Nonclay refractories shipments increased 21 percent to $1,140 million in 1988 from $943 million in 1987. Magnesite and chrome predominating brick and shapes totaled $275 million, 24 percent of the nonclay shipments.

A description of the survey methodology and related information appears on page 7.

Table 1. VALUE OF SHIPMENTS OF REFRACTORIES: 1988 to 1983

(Thousands of dollars)

Year	Total	Clay	Nonclay
1988	1,964,584	824,354	1,140,230
1987	1,682,338	739,770	942,568
1986	1,521,323	670,002	831,321
1985	1,581,701	694,432	887,269
1984	1,632,402	754,460	877,942
1983	1,398,123	663,829	734,294

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Table 2. QUANTITY AND VALUE OF SHIPMENTS OF REFRACTORIES, BY TYPE: 1988 AND 1987

(Value in thousands of dollars)

Product code	Product description	1988 Number of companies	1988 Quantity shipped (unit of measure) Short tons	1988 Quantity shipped (unit of measure) Metric tons	1988 Quantity shipped (unit of measure) M bricks (thousand 9-inch equivalent)	1988 Value of shipments	1987 Quantity shipped (unit of measure) Short tons	1987 Quantity shipped (unit of measure) Metric tons	1987 Quantity shipped (unit of measure) M bricks (thousand 9-inch equivalent)	1987 Value of shipments
	Clay and nonclay refractories	(X)	(X)	(X)	(X)	1,964,584	(X)	(X)	(X)	1,682,338
3255- --	Clay refractories	(X)	(X)	(X)	(X)	824,354	(X)	(X)	(X)	739,770
	Brick and shapes:									
32550 11	Fire clay (including semisilica) brick and clay, except superduty	24	217,968	197,614	50,325	47,573	239,108	216,780	67,151	47,446
32550 16	Bloating and superduty fireclay brick and shapes	24								
32550 25	High alumina brick and shapes containing 50% alumina and over, including high alumina ladle brick, hot top refractories and glass tanks (made predominantly of bauxite, kyanite, andalusite, and similar raw materials)[1]	27	509,875	462,262	92,151	197,630	470,973	426,990	123,651	173,004
32550 33	Pouring pit refractories, fireclay and high alumina (containing 50% alumina and over), including sleeves, nozzles, runners, tuyeres, and ladle gate parts (made predominantly of bauxite, kyanite, andalusite, and similar raw materials)	14	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
	Insulating fire brick and shapes[2]	(X)	54,803	49,685	41,219	44,222	32,156	29,153	28,881	23,648
32550 35	Under 2600 degrees F[1]	6	38,399	34,813	31,759	28,916	22,662	20,546	22,912	16,667
32550 37	2600 degrees F and over[1]	8	16,404	14,872	9,460	15,306	9,494	8,607	5,969	8,981
32550 49	Clay kiln furniture, radiant heater elements, potters' supplies, and other miscellaneous shaped refractory items	15	(D)	(D)	(X)	(D)	(D)	(D)	(X)	(D)
	Unshaped clay refractories:									
32550 55	Refractory bonding mortars wet and dry, less than 50% alumina[1]	27	57,124	51,790	(X)	31,876	56,366	51,102	(X)	28,373
32550 57	High alumina bonding mortars, wet and dry, 50% alumina and over made predominantly of bauxite, kyanite, andalusite, and similar raw materials)[3]	27	24,902	22,577	(X)	10,931	19,547	17,722	(X)	9,081
32550 61	Plastic refractories and ramming mixes, less than 50% alumina[1]	24	90,564	82,107	(X)	26,443	96,625	87,603	(X)	29,748
32550 64	High alumina plastic refractories and ramming mixes, 50% alumina and over (made predominantly of bauxite, kyanite, andalusite, and similar raw materials)[1 3]	30	63,119	57,225	(X)	31,925	62,885	57,012	(X)	32,635
32550 66	Phosphate bonded high alumina, plastic and ramming mixes, 50% alumina and over (made predominantly of bauxite, kyanite, andalusite, and similar raw materials)	19	62,499	56,663	(X)	28,139	48,174	43,675	(X)	23,021
	Castable refractories (hydraulic setting):									
32550 65	Castable refractories (hydraulic setting) less than 50% alumina[1]	27	113,555	102,951	(X)	33,467	110,028	99,754	(X)	32,568
32550 67	High alumina castable refractories (hydraulic setting) 50% alumina and over (made predominantly of bauxite, kyanite, andalusite and similar raw materials)	31	114,168	103,507	(X)	67,980	98,599	89,391	(X)	63,465
32550 69	Insulating castables (hydraulic setting) (density up to 105 lbs./cubic foot)[4]	27	46,649	42,293	(X)	21,155	38,167	34,603	(X)	18,298
32550 70	Insulating gunning mixes (hydraulic setting)	11	7,473	6,775	(X)	3,177	7,630	6,917	(X)	3,243
32250 71	Fireclay gunning mixes (including hydraulic setting gunning mixes less than 50% alumina	23	121,873	110,492	(X)	35,133	93,266	84,557	(X)	27,158
32550 75	High alumina gunning mixes, 50% alumina and over (made predominantly of bauxite, kyanite, andalusite, and similar raw materials, including hydraulic and phosphate bonded gunning mixes)[1]	25	52,530	47,625	(X)	19,171	41,528	37,650	(X)	17,535
	Other clay refractory materials sold in lump or ground form either for direct use by customer as a finished refractory product or as exported material	(X)	843,569	764,795	(X)	108,359	939,525	851,790	(X)	112,454
32550 85	Clay and high alumina refractory materials[5]	27	703,057	637,404	(X)	94,408	793,035	718,980	(X)	100,826
32550 95	Clay and high alumina refractory raw materials[6]	16	140,512	127,391	(X)	13,951	144,490	132,810	(X)	11,628
32550 00	Clay refractories n.s.k.[7]	(X)	(X)	(X)	(X)	38,372	(X)	(X)	(X)	34,435
	Nonclay refractories	(X)	(X)	(X)	(X)	1,140,230	(X)	(X)	(X)	942,568
	Brick and shapes:									
32970 12	Silica brick and shapes	7	27,871	25,288	8,371	22,563	30,570	27,715	6,933	19,450
	Magnesite and magnesite-chrome brick and shapes, and chrome brick:									
32970 13	Magnesite-carbon brick and shapes, less than 7% carbon (predominantly pitch or resin bonded)	9	33,242	30,138	7,423	30,891	27,832	25,293	7,134	24,070
32970 14	Magnesite-carbon brick and shapes, 7% carbon and over (predominantly pitch or resin bonded)	6	39,674	35,969	11,577	72,286	42,290	38,350	10,844	67,092
32970 17	Carbon impregnated magnesite brick and shapes	9	24,793	22,478	5,727	29,381	13,313	12,069	3,766	15,430
32970 15	Magnesite brick and shapes, burned and unburned	9	24,044	21,799	5,277	18,221	19,400	17,589	4,510	16,300
32970 19	Magnesite-chrome brick and shapes, high fired (3050 degrees F and over)	7	90,903	82,414	16,341	74,349	95,662	86,729	18,387	63,398
32970 20	Magnesite-chrome brick and shapes, except high fired, including burned and unburned brick as well as chrome brick	9	23,926	21,690	4,920	28,810	25,111	22,766	4,645	21,495

See footnotes at end of table.

Table 2. QUANTITY AND VALUE OF SHIPMENTS OF REFRACTORIES, BY TYPE: 1988 AND 1987--Continued

(Value in thousands of dollars)

Product code	Product description	Number of companies	1988				1987			
			Quantity shipped (unit of measure)				Quantity shipped (unit of measure)			
			Short tons	Metric tons	M bricks (thousand 9-inch equivalent)	Value of shipments	Short tons	Metric tons	M bricks (thousand 9-inch equivalent)	Value of shipments
	Nonclay Refractories--Continued									
	Brick and shapes--Continued									
32970 33	Carbon and graphite crucibles, retorts, stopper heads, brick, block, and other shaped refractories, including natural graphite refractories	12	28,559	25,892	4,673	58,617	17,635	15,988	1,840	38,636
32970 48	Silicon carbide kiln furniture (made predominantly of silicon carbide)	8	4,054	3,675	364	15,377	3,108	2,818	707	12,080
32970 49	Silicon carbide bricks and shapes (made predominantly of silicon carbide), except kiln furniture	13	9,747	8,837	1,308	46,450	7,073	6,413	1,106	33,774
32970 52	Mullite brick and shapes (made predominantly of synthetic or fused mullites)[8]	20	25,139	22,792	4,470	35,675	14,325	12,987	2,938	19,450
32970 53	Extra-high alumina brick and shapes and extra-high alumina pouring pit refractories, including sleeves, nozzles, runners, tuyeres, and ladle gate parts (made predominantly of fused and synthetic aluminas)	24	32,079	29,094	3,459	84,473	22,348	20,261	3,122	57,352
32970 55	Zircon and zirconia brick and shapes (made predominantly of either of these materials)	16	5,333	4,835	1,771	23,917	5,050	4,578	1,752	22,801
32970 58	All other brick and shapes including basic pouring pit refractories, molten shapes, dolomite, dolomite-magnesite, forsterite, magnesite, pyrophilite, pyrophilite-zircon, and all other brick and shapes not listed elsewhere	16	172,474	156,368	4,248	147,083	154,247	139,842	4,253	138,589
	Unshapes nonclay refractories:									
	Mortars:									
32970 62	Extra-high alumina mortars (made predominantly of fused or synthetic alumina and mullite)[1]	23	12,815	11,618	(X)	12,201	6,860	6,219	(X)	6,243
32970 63	Basic bonding mortars (made predominantly of magnesite or chrome ore) and other nonclay mortars (made predominantly of forsterite, zircon, and silica)	14	(D)	(D)	(X)	(D)	(D)	(D)	(X)	(D)
	Plastic refractories and ramming mixes, wet and dry types, and castables of nonhydraulic setting type:									
32970 65	Basic castables, plastics and ramming mixes (wet and dry types)	13	55,578	50,388	(X)	23,360	61,258	55,537	(X)	24,477
32970 64	Extra-high alumina plastics and ramming mixes (made predominantly of fused or synthetic aluminas and mullite)	14	25,984	23,558	(X)	27,542	23,753	21,535	(X)	26,390
32970 66	Extra-high alumina phosphate bonded plastics and ramming mixes (made predominantly of fused or synthetic aluminas and mullite)	20	29,539	26,781	(X)	29,560	13,601	12,332	(X)	14,436
32970 69	Other nonclay plastic refractories and ramming mixes (forsterite, zircon, etc.)	16	40,194	36,441	(X)	23,586	47,525	43,087	(X)	28,745
32970 68	Extra-high alumina castables (hydraulic setting) (made predominantly of fused or synthetic alumina and mullite)[1]	23	24,165	21,908	(X)	21,292	17,561	15,921	(X)	16,850
32970 93	Other nonclay refractory castables (hydraulic setting)	19	6,091	5,522	(X)	5,143	6,630	6,011	(X)	5,610
	Gunning mixes:									
32970 72	Basic nonclay gunning mixes (including chrome, chrome-magnesia, magnesia-chrome, magnesia, and dolomite) and other nonclay gunning mixes (fosterite, zircon, etc.)	17	(D)	(D)	(X)	(D)	(D)	(D)	(X)	(D)
	Ceramic refractory fibres:									
32970 75	1300 to 2000 degrees F	5	(D)	(D)	(X)	(D)	(D)	(D)	(X)	(D)
32970 78	2001 to 2400 degrees F	9	30,764	27,891	(X)	55,918	17,787	16,126	(X)	42,955
32970 80	2401 to 2700 degrees F	4	(D)	(D)	(X)	(D)	(D)	(D)	(X)	(D)
32970 84	2701 degrees F and higher	4	(D)	(X)	(D)	(D)	(D)	(D)	(X)	(D)
	Other nonclay refractory materials in lump or ground form including ground silica	(X)	246,354	223,349	(X)	63,659	196,786	178,410	(X)	44,530
32970 94	Domestic shipments for direct use by customers as a finished refractory and all exported material[5]	19	104,302	94,562	(X)	35,254	81,307	73,714	(X)	24,090
32970 96	All other domestic shipments of nonclay refractory materials sold in lump or ground form as a refractory raw material[6]	15	142,052	128,787	(X)	28,485	115,479	104,696	(X)	20,440
32970 00	Nonclay refractories n.s.k.[7]	(X)	(X)	(X)	(X)	37,867	(X)	(X)	(X)	31,303
32950 23	Dead-burned magnesia or magnesite:[5 9] Domestic shipments for direct use as finished refractory products and all exported material	7	101,504	92,025	(X)	22,799	162,144	147,003	(X)	39,330
32950 25	All other domestic shipments predominantly for use as a refractory raw material	9	348,854	316,277	(X)	81,377	(D)	(D)	(X)	(D)
32740 71	Dead-burned dolomite	4	226,541	205,386	(X)	12,171	330,107	299,282	(X)	20,571

(D) Data withheld to avoid disclosing figures for individual companies. N.s.k. Not specified by kind.
(X) Not applicable.

[1]Excludes data for mullite and extra-high alumina refractories. These products are included in the nonclay refractories section. [2]The subdivisions are in accordance with the ASTM classification C-155, the respective groups being 16, 20, 23 combined with 26 and 28 and higher. [3]Includes products referred to as plastic firebrick and the less plastic materials intended for ramming into place after the addition of water (when shipped in dry form). [4]Includes hydraulic setting castables designed for low thermal conductivity and having bulk densities as defined in ASTM classification C-401, not greater than 105 pounds/cubic foot. [5]Includes shipments for direct use as finished refractory products by establishments classified in manufacturing industries and excludes shipments to refractory producers for reprocessing in the manufacture of brick and other refractories. Includes all exports. [6]Includes shipments to refractory producers for reprocessing the manufacture of brick and other refractories. [7]Not specified by kind (n.s.k.) represents the value of shipments for establishments which did not report detailed information and establishments, typically with less than five employees which were not included on the MA33C mailing panel. [8]"Fused" as applied to bauxite and alumina means complete melting, as in an electric furnace; after cooling, the product is crushed and graded for use in the refractory. [9]Total does not include shipments of dead-burned magnesia or magnesite for direct use as finished refractory products, which is not classified as refractories under the Standard Industrial Classification system.

Table 3. SHIPMENTS, EXPORTS, IMPORTS, AND APPARENT CONSUMPTION OF REFRACTORIES, BY TYPE: 1988 AND 1987

(Value in thousands of dollars)

Product code[1]	Product description	Unit of measure	Manufacturers' shipments		Exports of domestic merchandise[1,2]			Percent exports to manufacturers' shipments		Imports for consumption[1,4]		Apparent consumption[6]		Percent imports to apparent consumption	
			Quantity	Value	Quantity	Value at port[2]	Estimated producers' value[3]	Quantity	Value	Quantity	Value[5]	Quantity	Value	Quantity	Value
	1988														
	Clay and nonclay refractories[7]	(X)	(X)	1,811,825	(X)	292,054	250,204	(X)	14	(X)	158,112	(X)	1,719,733	(X)	9
	Clay refractories	(X)	(X)	785,982	(X)	123 *28	106,084	(X)	13	(X)	13,526	(X)	693,424	(X)	2
32250 11,16,25, 35,37	Brick and shapes	Thousand standard brick equivalent	183,695	289,425	109,578	83, 71	71,253	60	25	(NA)	3,576	(NA)	221,748	(NA)	2
32550 55,57,61, 64,65,66,67, 69,70,71,75	Refractory and heat-insulating mortars, ramming and gunning mixes, and castables: Plastic refractories, ramming and gunning mixes, hydraulic-setting castable refractories, and other clay refractory mortars and gunning mixes	Short tons	756,456	309,397	(NA)	40,657	34,831	(NA)	7	(NA)	475	(NA)	471,676	(NA)	2
32550 33,49, 85,95	Shaped refractories, hot-topped refractories, and other clay refractory materials	do	(X)	187,160						2,178	9,475				
	Nonclay refractories	(X)	(X)	1,025,843	(X)	168,226	144,120	(X)	14	(X)	144,586	(X)	1,026,309	(X)	14
32970 12,13,14, 15,17,19,20	Brick and shapes: Magnesite, chrome, magnesite-chrome brick, and silica brick and shapes	Thousand standard brick equivalent	59,636	274,501	25,406	68,482	58,669	34	10	27,530	20,415	(X)	594,479	(X)	7
32970 49,52,53, 55,98	Other nonclay refractory brick and shapes (except crucibles)	do	15,256	337,598						(X)	70,634				
32970 62,63,64, 65,66,68,69,72, 93	Refractory and heat-insulating mortars, ramming and gunning mixes, and castables: Plastic refractories, ramming and gunning mixes, hydraulic-setting castable refractories, and other clay refractory mortars and gunning mixes	Short tons	591,939	276,091	(NA)	56,527	48,427	(NA)	18	(NA)	26,930	(NA)	254,594	(NA)	11
32970,33,48,94,96	Shaped refractories, hot-topped refractories, and other nonclay refractory materials	do	(X)	137,653	(X)	43,217	37,024	(X)	27	(X)	76,607	(X)	177,236	(X)	43
	1987														
	Clay and nonclay refractories[7]	(X)	(X)	1,546,050	(X)	203,191	174,074	(X)	11	(X)	151,567	(X)	1,523,543	(X)	9
	Clay refractories	(X)	(X)	705,335	(X)	92,031	78,843	(X)	11	(X)	10,710	(X)	637,202	(X)	1
32250 11,16,25, 35,37	Brick and shapes	Thousand standard brick equivalent	218,764	233,076	81,823	56,356	48,280	37	21	(NA)	5,738	(NA)	190,534	(NA)	3
32550 55,57,61, 64,65,66,67, 69,70,71,75	Refractory and heat-insulating mortars, ramming and gunning mixes, and castables: Plastic refractories, ramming and gunning mixes, hydraulic-setting castable refractories, and other clay refractory mortars and gunning mixes	Short tons	672,815	285,125	23,515	11,397	9,764	3	3	268	252	649,568	275,613	(Z)	(Z)
32550 33,49, 85,95	Shaped refractories, hot-topped refractories, and other clay refractory materials	do	(X)	187,134	(NA)	26,278	20,799	(X)	11	587	4,770	(X)	171,055	(X)	3
	Nonclay refractories	(X)	(X)	840,715	(X)	111,160	95,231	(X)	11	(X)	140,857	(X)	886,341	(X)	16
32970 12,13,14, 15,17,19,20	Brick and shapes: Magnesite, chrome, magnesite-chrome brick, and silica brick and shapes	Thousand standard brick equivalent	56,219	227,235	9,460	25,095	21,499	(X)	9	52,436	38,153	(X)	243,889	(X)	16
32970 49,52,53, 55,98	Other nonclay refractory brick and shapes (except crucibles)	do	13,171	271,966	9,920	28,420	24,347	75	9	(X)	19,404	(X)	267,023	(X)	7
32970,62,63, 64,65,66,68, 69,72,93	Refractory and heat-insulating mortars, ramming and gunning mixes, and castables: Plastic refractories, ramming and gunning mixes, hydraulic-setting castable refractories, and other clay refractory mortars and gunning mixes	Short tons	530,823	244,268	33,834	25,319	21,691	6	9	34,917	19,490	531,906	244,067	7	8
32970 33,48,94, 96	Shaped refractories, hot-topped refractories, and other nonclay refractory materials	do	(X)	95,266	(X)	32,326	27,694	(X)	29	(X)	63,810	(X)	131,362	(X)	49

(NA) Not available. (X) Not applicable. (Z) Less than one-half of 1 percent.

[1] For comparison of SIC-based codes with Schedule B export numbers and TSUSA import numbers, see table 4.

[2] Source: Bureau of the Census report EM 546, U.S. Exports.

[3] These values were derived by use of adjustment factors to exclude freight, insurance, and other charges incurred in moving goods to the point of export. This adjustment is made to convert the values to an approximation of the producers' value of exported goods. Current adjustment factors are based on data for 1983 which are published in Origin of Exports of Manufactured Products, MA3(AS)-5, appendix B. The adjustment factor for this report is .8567.

[4] Source: Bureau of the Census report IM 145-X, U.S. Imports for Consumption and General Imports.

[5] Value at port includes both import value and duty value.

[6] Apparent consumption is derived by subtracting exports from the total of shipments plus imports (including duty).

[7] The clay and nonclay refractories total shown here exclude product codes 32550 (X) and 32970 (X); therefore, they differ from the totals shown in tables 2 and 3.

Table 4. COMPARISON OF STANDARD INDUSTRIAL CLASSIFICATON-BASED CODES, SCHEDULE B EXPORT NUMBERS, AND TSUSA IMPORT NUMBERS: 1988

Product code	Product description	Export number	Product description	Import number	Product description
	Clay refractories:		Refractory and heat-insulating bricks of all sizes and shapes of clay:		
	Brick and shapes:				
32550 11	Fire clay (including semisilica) brick and clay, except superduty	531.2710	Fire clay brick shapes except high alumina		
32550 16	Bloating and superduty fire clay brick and shapes				
32550 25	High alumina brick and shapes including high alumina ladle brick (50% alumina and over) and hot top refractories and glass-house pots, tank blocks, feeder pots and upper structure shapes used only for glass tanks	531.2720	High alumina bricks and shapes	531.2705	Refractory and heat-insulating bricks of all sizes and shapes: Clay
			Shaped refractory and heat-insulating articles n.s.p.f., and structures of refractory or heat insulating articles:		Shaped refractory and heat-insulating articles not n.s.p.f., and structures
		531.4110			
		531.4120	Of clay:		
			Construction materials	531.3100	Pins, spurs, stilts, and thimbles, all the foregoing used in the manufacture of ceramic articles
32550 31	Bloating fire clay ladle brick		Other		
32550 33	Pouring pit refractories, fireclay and high alumina (containing 50% alumina and over) includes sleeves, gate parts (made predominantly of bauxite, kyanite, andalusite, and similar raw materials)	531.2730	Other (including fire clay brick and shapes, and plastic firebrick)		
	Insulating firebrick and shapes:				
32550 35	Under 2600 degrees F				
32550 37	2600 degrees F and higher				
32550 61	Plastic refractories and ramming mixes (less than 50% alumina)	531.1125	Refractory and heat-insulating mortars, ramming mixes, and castables, super refractory powders: Of clay: Plastic refractories, ramming and gunning mixes		
32550 64	High alumina plastic refractories and ramming mixes (50% aluumina and over)				
32550 66	Phosphate bonded high alumina, plastic and ramming mixes (50% alumina and over)				
32550 65	Castable refractories (hydraulic setting) (less than 50% alumina)				
32550 67	High aluminum castable refractories (hydraulic setting) (50% alumina and over)	531.1130	Hydraulic-setting castable refractories	531.1120	Refractory and heat insulating mortars, ramming sizes, and castables; super refractory powders: Clay
32550 69	Insulating castables (hydraulic setting) (density up to 105 lbs/cubic foot)				
32550 55	Refractory bonding mortars, wet and dry types, less than 50% alumina				
32550 57	High alumina bonding mortars, wet and dry (50% alumina and over)				
32550 71	Fire clay gunning mixes, including hydraulic setting gunning mixes (less than 50% alumina)	531.1135	Other		
32550 70	Insulating gunning mixes (hydraulic setting)				
32550 75	High alumina gunning-mixes (50% alumina and over)				
32550 49	Clay kiln furniture, radiant heater elements, potters supplies, and other miscellaneous shaped refractory items				
	Other clay refractory materials sold in lump or ground form:			531.3500	Earthenware and stoneware crucibles
32550 85	Clay and high alumina refractory materials			531.3910	Other: Clay
32550 95	Clay and high alumina refractory raw materials				
	Nonclay refractories:		Refractory and heat-insulating bricks of all sizes and shapes:		Refractory and heat-insulating bricks:
	Brick and shapes:				
32970 13, 14,17,15, 19,20	Magnesite and magnesite-chrome brick and shapes and chrome brick (excluding molten cast)	531.2400	Magnesite bricks	531.2400	Magnesite bricks
		531.2100	Chrome bricks	531.2100	Chrome bricks

Table 4. COMPARISON OF STANDARD INDUSTRIAL CLASSIFICATON-BASED CODES, SCHEDULE B EXPORT NUMBERS, AND TSUSA IMPORT NUMBERS: 1988--Continued

Product code	Product description	Export number	Product description	Import number	Product description
	Nonclay refractories--Continued				
	Brick and shapes--Continued				
32970 12 32970 52	Silica brick and shapes Mullite brick and shapes made predominantly of synthetic or fused mullites.	531.2770	Silica bricks and shapes		
32970 53	Extra-high alumina brick and shapes and pouring pit refractories	531.2760	Heat-insulating bricks and shapes of infusorial earths, kieselguhr and similar earths		
32970 49	Silicon carbide brick and shapes made predominantly of silicon carbide, except kiln furniture			531.2750	Other bricks Other (nonclay)
32970 55	Zircon and zirconia brick and shapes made predominantly of either of these materials				
35970 58	All other brick and shapes including basic pouring pit refractories, molten cast shapes, dolomite, dolomite magnesite, forsterite, magnesite, pyrophilite, pyrophilite-zircon, and all other brick and shapes n.e.c.	531.2780	Other nonclay bricks and shapes		
32970 33	Carbon and graphite crucibles, retorts, stopper heads, brick, block, and other shaped refractories, including natural graphite refractories				
			Refractory and heat-insulating mortars, ramming mixes, and castables, super refractory powders: Other (nonclay)		
32970 68 93	Extra high alumina castables and other nonclay refractory castables	531.1150	Hydraulic-setting castable refractories		
	Plastic refractories and ramming mixes (wet or dry types) and castables of nonhydraulic setting type:				
32970 65	Basic castables, plastics, and ramming mixes	531.1145	Plastic refractories, ramming and gunning mixes	531.1140	Refractory and heat-insulating mortars, ramming mixes, and castables, super refractory powders Other (nonclay)
32970 64, 66, 69	Other nonclay plastic refractories and ramming mixes				
	Mortars:				
32970 61	Basic bonding mortars (predominantly of magnesite or chrome ore)				
32970 62	Extra high alumina mortars				
32970 63	Other nonclay refractory mortars				
32970 71	Basic nonclay gunning mixes (including chrome, chrome-magnesia, magnesia-chrome, magnesia, and dolomite)	531.1155	Other		
32970 73	Other nonclay gunning mixes (forsterite, zircon, etc.)				
			Shaped refractory and heat-insulating articles, n.e.s.p.f., and structures or refractory or heat insulating articles		Shaped refractory and heat-insulating articles n.e.s.p.f., and structures of refractory or heat insulating articles
32970 48	Silicon carbide kiln furniture made predominantly of silicon carbide		Other (nonclay)	531.3300	Carbon or graphite crucibles
		531.4410	Construction materials	531.3920	Other Other (nonclay)
32970 94	Domestic shipments for direct use by customers as finished refractory and all exported material	531.4420	Other		
	Other non-clay refractory materials in lump or ground form including ground silica				
32970 96	All other domestic shipments of other nonclay refractory materials sold in lump or ground form as a refractory raw material				

N.e.s.p.f. Not specifically provided for.

DESCRIPTION OF SURVEY

Scope of Survey. This survey covers all companies engaged in the manufacture of refractories.

Survey Methodology. The statistics in this publication were collected by mail on Bureau of the Census annual Form MA32C, Shipments of Refractories. The survey panel for this survey includes all known manufacturers of refractories, approximately 100 companies.

Reliability of Data. Survey error may result from several sources: (1) inability to obtain information about all cases in the survey; (2) response errors; (3) definitional difficulties; (4) differences in the interpretation of questions; (5) mistakes in recording or coding the data obtained; and (6) other errors of collection, response, coverage, and estimation for missing data. These nonsampling errors also occur in complete censuses. Although no direct measurement of the biases due to nonsampling errors has been obtained, precautionary steps were taken in all phases of the collection, processing, and tabulation of the data in an effort to minimize their influence.

A major source of bias in the published estimates is due to imputing data for nonrespondents, for late reporters, and for data which fail logic edits. Missing figures are imputed based on year-to-year movements shown by reporting firms. Imputation generally is limited to a maximum of 10 percent for any one data cell. Figures with imputation rates greater than 10 percent are footnoted.

The imputation rate is not an explicit indicator of the potential error in published figures due to nonresponse, because the actual yearly movements for nonrespondents may or may not closely agree with the imputed movements. The range of difference between the actual and imputed figures is not precisely known, but is assumed to be small. The degree of uncertainty regarding the accuracy of the published data, however, increases as the percentage of imputation increases. Figures with imputation rates above 10 percent should be used with caution.

Revisions to Previous Period Data. Data may be revised as the result of corrected figures from respondents, annual reports received for which imputations were originally made as described, or other corrections. Figures which have been revised by more than 5 percent from previously published figures are indicated by footnotes.

EXPLANATION OF TERMS

Quantity and Value of Shipments. The figures on quantity and value of shipments represent physical shipments of all products sold, transferred to other establishments of the same company, or shipped on consignment, whether for domestic or export sale. The value represents the net sales price, f.o.b. plant, to the customer or branch to which the products are shipped, net of discounts, allowances, freight charges, and returns. Shipments to a company's own branches are assigned the same value as comparable sales to unaffiliated customers; i.e., the value includes an appropriate allocation of company overhead and profit. Products bought and resold without further manufacture are excluded.

Units of Measure. Data for quantity of shipments have been collected in two distinct units of measure. Shipments of all refractories are collected in metric tons, and shipments of bricks and shapes are also collected in thousand 9-inch equivalents. (A 9-inch equivalent is a solid volume of 101.25 cubic inches.) For ease of comparison, the metric tons data have been multiplied by the appropriate factor (1.103) to derive the short tons figures.

High Alumina Brick and Shpaes (50 Percent $A1_2O_3$). Bricks and shapes made substantially of calcined diaspore or bauxite. Calcined as applied to diaspore and bauxite implies heat treatment short of fusion for volume stability prior to use in a refractory product. In the process, volatile materials are driven off and chemical changes take place.

Ladle Brick. Alumina ladle brick less than 50 percent $A1_2O_3$.

High Alumina Ladle Brick. Ladle brick containing 50 percent or more $A1_2O_3$.

Sleeves, Nozzles, Runner Brick, Tuyeres, and Side Grate Brick. Includes nozzles and sleeves described in American Society of Testing and Materials (ASTM) C-435, runner brick, tuyeres, and slide gate brick, externally applied, all compositions.

Refracotry Bonding Mortars, Wet and Dry Types. Includes both airsetting and heat-setting bonding mortars which contain up to 60 percent $A1_2O_3$, dry basis, by analysis.

Plastic Refractories and Ramming Mixes. Includes products referred to as plastic fire brick and the less plastic materials intended for ramming into place after the addition of water (when shipped in dry form) containing less than 50 percent $A1_2O_3$.

High Alumina Plastic Refractories and Ramming Mixes. Plastic refractories and ramming mixes containing 50 percent to 87.5 percent $A1_2O_3$.

Clay Castable Refractories (Hydraulic Setting). Hydraulic setting castables containing up to 50 percent $A1_2O_3$ and made from calcined fireclay, diaspore or bauxite base,

and Portland or calcium aluminate cements. Castables based on mullite, fused or tabular alumina, or other nonclay materials are excluded.

High Alumina Castable Refractories (Hydraulic Setting). Castable refractories containing more than 50 percent Al_2O_3, excluding those based on mullite or extra high alumina.

Insulating Castables. Hydraulic setting castables designed for low thermal conductivity and having bulk densities as defined in ASTM Classification C-401 no greater than 105 pounds per cubic foot.

Fireclay Gunning Mixes. Alumino-silicate compositions up to 50 percent Al_2O_3 specifically engineered for gunning applications, may include hydraulic setting or other chemical bonding agents.

Molten Cast Refractories. Products made by fusing refractory oxides, as in an electric furnace, and pouring the molten material into molds to form finished shapes.

Magnesite and Magnesite-Chrome Brick and Shapes (Magnesite Predominating; Products Analyzing Greater than 55 percent Mg). Pitch-bonded magnesite and magnesite-dolomite brick (magnesite predominating), not including burned impregnated brick, molten cast magnesite and magnesite-chrome brick and shapes, or those made of fused magnesia.

Chrome and Chrome-Magnesite Brick and Shapes. Chrome predominating products analyzing no more than 55 percent MgO. Molten cast chrome and shapes are excluded.

Mullite Brick and Shapes. Mullite brick and shapes made predominantly of kyanite, sillimanite, and alusite, or synthetic mullite (excluding molten cast).

Extra High Alumina Brick and Shapes (Over 87.5 Percent Al_2O_3). Products made predominantly of fused bauxite or fused or densesintered alumina. Molten cast extra high alumina brick and shapes are excluded.

Fused. As applied to bauxite and alumina, fused means melting, as in an electric furnace; after cooling, the product is crushed and graded for use in the refractory.

Dense-Sintered Alumina. Refer to heat treatment (short of melting) to render it relatively volume-stable for use in a refractory.

High Alumina Mortars. Mortars containing more than 60 percent Al_2O_3.

Other Nonclay Mortars. Includes for sterite, zircon, zirconia, mullite, etc.

Nonclay Castable Refractories (Hydraulic Setting). Hydraulic setting castables made from nonclay refractory materials and Portland or calcium aluminate cements.

Basic Nonclay Gunning Mixes. Includes chrome, chrome-magnesia, and dolomite gunning mixes.

Other Nonclay Gunning Mixes. Includes extra high alumina, mullite, zircon, and other gunning mixes.

COMPARISON OF EXPORT, IMPORT, AND DOMESTIC OUTPUT DATA

The Standard Industrial Classification (SIC) system used for domestic output and the statistical export and import commodity classifications were developed independently. This results in considerable difficulty in comparing the three types of data for many commodity areas. The domestic output classification is based on type of industry; on the other hand, the export and import classification system is more materials oriented. Also, there are a substantial number of imported commodities which have no comparable domestic output classification. The relationships shown in this report should be considered only as approximations, since, in addition to the problems mentioned above, there are also the following problems affecting the comparability of the three sets of data.

Valuation. There are different methods of valuation for the three types of data:

- *Domestic Output.* Valued at the point of production. It includes the net sales price, f.o.b. plant, after discounts and allowances, exclusive of freight charges and excise taxes.
- *Exports.* Valued at the point of exportation. It includes the selling price, or cost if not sold, and inland freight, insurance and other charges to the export point.

  Estimated producers' values of exports have also been developed. These values more closely approximate the values reported for domestic output because they exclude freight, in surnance, and other charges applied from the producing plant to the export point.
- *Imports.* Valued at the first port of entry in the United States. It included c.i.f. (cost, insurance, and freight), duty, and other charges to the import point.

Duplication in Quantity and Value of Output. Because producers' shipments of some commodities may be used as materials for incorporation into other commodities, combinations of data for such commodities may contain a certain amount of duplication. Thus, percentages of exports to output or imports to apparent consumption (output plus imports minus exports) at fourdigit or broader levels may be understated. Where duplication is known to be substantial, the output data are appropriately noted in the table.

Low-Value Import and Export Transactions. Detailed commodity information is not included for individual export shipments valued at not more than $1,500. Generally, detailed commodity information is not included for individual import shipments valued at not more than $1,000. For textiles and textile products, gloves, footwear, and miscellaneous rubber and plastics products, detailed commodity information is not included for individual import shipments valued at not more than $250. This is believed to have only negligible effects on the statistics for the bulk of the commodities.

Manufacturers' Shipments, Not Specified by Kind. The value of manufacturers' shipments at the four-digit industry level often includes a small amount which is not distributed among the individual five-digit product classes. Export and import percentages at the more detailed levels might, therefore, be slightly overstated.

Time Lag Between Output and Exports. There will be a lag between the time a commodity is produced or shipped by the producer and the time it is actually exported, especially when intermediaries (wholesalers, exporters, etc.) are involved. Ordinarily, this type of discrepancy is insignificant in annual figures.

"Direct" vs "Total" Commodity Exports and Imports. Export and import data do not include materials which are incorporated into other more finished products and exported or imported in finished form. Thus, by showing only direct exports and imports, the relation of exports to output and imports to apparent consumption for intermediate products is considerably understated.

Used Commodities. With a few exceptions, used or rebuilt commodities are classified in the same import or export codes as is new merchandise. Percentages are thus overstated to the extent that used or rebuilt products are significant in trade.

Geographic Area of Coverage. Import and export data reflect the movement of merchandise into and out of U.S. foreign trade zones, the U.S. Virgin Islands, and the U.S. customs territory (includes the 50 States, the District of Columbia, and Puerto Rico).

HISTORICAL NOTE

Data on refractories have been collected by the Bureau of the Census since 1947. Historical data may be obtained from Current Industrial Reports (called Facts for Industry before 1959) available at your local Federal Depository Library. A list of these libraries may be obtained from the Bureau of the Census regional offices:

Office	Telephone
Atlanta, Georgia	(404) 347-2271
Boston, Massachusetts	(617) 223-2327
Charlotte, North Carolina	(704) 371-6142
Chicago, Illinois	(312) 353-6251
Dallas, Texas	(214) 767-0621
Denver, Colorado	(303) 236-2200
Detroit, Michigan	(313) 226-7742
Kansas City, Kansas	(816) 374-4601
Los Angeles, California	(213) 209-6616
New York, New York	(212) 264-3860
Philadelphia, Pennsylvania	(215) 597-4920
Seattle, Washington	(206) 442-7828

Historical data are also available on microfiche. For further information contact the Bureau of the Census, Data User Services Division, (301) 763-4100.

RELATED REPORTS

The Bureau of the Census also publishes the following related reports:

Series	Frequency	Title
Current Industrial Reports		
M32D	Monthly	*Clay Construction Products*
MQ32A	Quarterly	*Flat Glass*
MA33B	Annually	*Steel Mill Products*
Other Industry Reports		
M3-1	Monthly	*Manufacturers' Shipments, Inventories, and Orders*
(AS)	Annually	Annual Survey of Manufactures (ASM)
(MC)	Quinquennially	Census of Manufactures
Foreign Trade Reports		
EM 546 FT 446	Monthly Annually	*U.S. Exports—Schedule B—Commodity by Country*
IM 146 FT 246	Monthly Annually	*U.S. Imports for Consumption—TSUSA—Commodity by Country*

CONTACTS FOR DATA USERS

Subject Area	Contact	Phone Number
Current Industrial Report MA32C	Nathaniel A. Shelton	(301) 763-1728

Subject Area	Contact	Phone Number
Manufacturers' Shipments, Inventories and Orders	Ruth Runyan	(301) 763-2502
Classification Systems Comparability	Francis McCormick (ESD)	(301) 763-1935
Foreign Trade	Trade Data Inquiries Staff (FTD)	(301) 763-5140
Census/ASM	Kenneth Hansen	(301) 763-7304
International Trade Administration	Brian Duggan	(202) 377-0608

Subject Area	Contact	Phone Number
To order a Current Industrial Report	Superintendent of Documents (GPO)	(202) 783-3238
To subscribe to a Census Bureau publication	Superintendent of Documents (GPO)	(202) 275-3054

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